Claims

1. A method of counting the number of ions in a gaseous sample which method comprises (i) colliding the ions with uncharged particles of greater mass than the ions to transfer charge from said ions to the uncharged particles to produce charged particles (ii) subjecting the charged and uncharged particles to an electric field to separate the charged particles from the uncharged particles and (iii) numerically counting the number of charged particles.

2. A method as claimed in claim 1 in which the electric field directs the charged particles to a counting means which can count the number of particles.

3. A method as claimed in claim 1 or 2 in which the sample is a steady flow of gas containing ions and is combined and mixed with a steady flow of uncharged particles, or nano-particles, or clusters, or molecules entrained in a gas and the combined flow is subjected to the electric field.

4. A method as claimed in claim 1 or 2 in which the charged and uncharged particles are separated in the separation chamber according to their electric mobility by the imposition of the electric field.

5. A method as claimed in any one of the preceding claims in which the gas flow from the outlet of the separation chamber contains only charged particles.

6. A method as claimed in any one of the preceding claims in which the number concentration of uncharged particles is in excess of the number concentration of the ions.

7. A method as claimed in any one of the preceding claims in which the ions and the uncharged particles are entrained in a gaseous flow.

8. A method as claimed in any one of the preceding claims in which the charged particles are detected and counted individually by means of single particle counting means.

9. A method as claimed in any one of the preceding claims in which the uncharged particles are formed as an aerosol for instance the atmospheric aerosol.

10. A method as claimed in any claim 9 in which the aerosol is produced by an evaporator and condensation means to produce the uncharged aerosol particles.

11. A method as claimed in claim 9 in which a semi-volatile material is used to generate aerosol particles

12. A method as claimed in claim 11 in which the semi-volatile material is glycerol or sulphur.

13. A method as claimed in any one of the claims 1 to 8 in which the uncharged particles are a liquid in the form of a hydrosol or emulsion.

14. A method as claimed in any one of the preceding claims in which the means for counting the particles is an optical particle counter, a light scattering or light absorption detector, a dust monitor, a nephelometer, an aethelometer or a condensation particle counter.

15. A method as claimed in any one of the preceding claims in which the electric field generating means comprises two spaced apart electrodes with an electric field generated between them.

16. A method as claimed in any one of the preceding claims in which the flow rates of the gases in the separation chamber satisfy "the laminar flow criterion".

17. A method as claimed in any one of the preceding claims in which the gas flow is laminar in the vicinity of the electric field and the charged particles migrate to a location in the gas flow cross-section dependant upon the electric mobility of the charged particles and the strength of the electric field.

18. A method as claimed in any one of the preceding claims in which there is ion mobility selection unit attached to the inlet of the mixing chamber to enable ions of pre-determined mobility to pass into the mixing chamber.

19. A method as claimed in any one of the preceding claims in which there is an ionisation chamber containing ionisation means for effecting ionisation of molecules or clusters of interest, attached to the inlet of the mixing chamber.

20. A method as claimed in claim 19 in which the ionisation means comprises a method of ionisation with a degree of selectivity.

21. A method as claimed in any one of the preceding claims for the detection of trace species in liquids or solids in which a liquid or a solid sample is evaporated first into a gas medium and then treated as a gas sample or a liquid or solid sample is heated to a predetermined temperature first to release some of the trace species in a gas medium and then the gas medium containing the trace species is treated as a gas sample.

22. A method as claimed in any one of the preceding claims in which there are a plurality of mixing chambers, arranged in series and/or in parallel, and a plurality of selection chambers, or particle generator means, arranged in series and/or in parallel.

23. A method as claimed in any one of the preceding claims in which the size and the mass of the charged aerosol particles or the detectable species are increased by subjecting the charged particles to a condensation process.

24. A method as claimed in any one of the preceding claims in which the gaseous flow through the second inlet in the mixing chamber passes through a charge neutralisation or charge removal means to ensure the neutrality of such flows.

25. A method as claimed in any one of the preceding claims in which the separation chamber is a differential mobility analyser.

26. A method as claimed in any one of the preceding claims in which the charged particles impinge upon the detecting and numeric counting means in a manner indicative of the magnitude of the respective charge.

27. An apparatus for counting the number of ions in a gaseous sample which apparatus comprises (i) a mixing chamber (ii) a first inlet in the mixing chamber through which a gaseous sample containing ions can enter (iii) a second inlet in the mixing chamber through which uncharged particles entrained in a gas can enter so that the ions and uncharged particles collide (iv) an outlet from the mixing chamber which discharges to a separation chamber which separation chamber has an electric field generating means and an outlet discharging to a charged particle detecting and numerically measuring means.

28. An apparatus as claimed in claim 27 in which the charged particle detecting and numerically measuring means comprises a single particle counting means.

29. An apparatus as claimed in claim 27 or 28 in which the charged particle detecting and numerically measuring means comprises an optical particle counter, a light

scattering or light absorption detector, a dust monitor, nephelometer, aethelometer or a condensation particle counter.

30. An apparatus as claimed in any one of claims 27 to 29 in which the electric field generating means is arranged to be able to subject the particles in the separation chamber to an electric field.

31. An apparatus as claimed in claim 30 in which the electric field generating means comprises two spaced apart electrodes with an electric field generated between them.

32. An apparatus as claimed in any one of claims 27 to 31 in which there is an ion mobility selection unit attached to the inlet of the mixing chamber to enable ions of pre-determined mobility to pass into the mixing chamber.

33. An apparatus as claimed in any one of claims 27 to 32 in which there is an ionisation chamber containing ionisation means for effecting ionisation of molecules or clusters of interest, attached to the inlet of the mixing chamber.

34. An apparatus as claimed in claim 33 in which the ionisation means comprises a method of ionisation with a degree of selectivity.

35. An apparatus as claimed in any one of claims 27 to 34 in which there is a condensation unit, adapted to increase the size and the mass of the charged aerosol particles or the detectable species positioned between the separation chamber and the charged particle detecting and numerically measuring means.

36. An apparatus as claimed in any one of claims 27 to 35 in which there is a charge neutralisation or charge removal means positioned before the second inlet to ensure the neutrality of particles flowing through the inlet.

37. An apparatus as claimed in any one of claims 27 to 36 in which the separation chamber is a differential mobility analyser.

38. Apparatus as claimed in any one of claims 27 to 37 in which there is an evaporator and, if appropriate, a condensation means arranged to produce the uncharged aerosol particles, or uncharged nano-particles, or neutral clusters, or molecules suspended in a gas medium, connected to the second inlet to the mixing chamber.

39. Apparatus as claimed in any one of claims 27 to 37 in which there is a second outlet from the separation chamber which is connected through pump means and aerosol filter means to a third inlet to the separating chamber, discharging in parallel to and adjacent the inlet to the separating chamber from the mixing chamber.

40. Apparatus as claimed in Claim 39 in which short baffles extending in the direction of flow are positioned within the separation chamber respectively adjacent inlet and outlet regions.